## REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-42, 47, and 48 are presently active; Claims 43-46, 49, and 50 having been withdrawn by a Restriction Requirement, and Claims 1-2, 7, 9, 19, 24, 25, 26, 28, 33, 34, 36, 41, 47and 48 have been presently amended.

In the outstanding Office Action, the specification was objected due to informalities. Figures 1-5, 7, 8, 9A, and 9B were objected to for not having sufficient labels. Claims 7, 26, and 34 were objected to. Claims 1-42, 47, and 48 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Claims 19-24 were rejected under 35 U.S.C. § 101 for being directed to non-statutory subject matter. Claims 1-7, 11-16, 19-23, 25, 26, 33, 34, and 47 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bunkofske et al (U.S. Pat. Appl. Publ. No. 2003/0055523) in view of Lundahl et al (U.S. Pat. Appl. Publ. No. 2002/0107858) and further in view of Toprac et al (U.S. Pat. No. 6,622,059). Claims 17, 29, 30, 37, 38, 41, and 48 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bunkofske et al in view of Lundahl et al in view of Toprac et al and further in view of Hsuing et al (U.S. Pat. Appl. Publ. No. 2003/0144746). Claims 8, 27, and 35 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bunkofske et al in view of Lundahl et al in view of Toprac et al and further in view of Wold et al (U.S. Pat. No. 5,949,678). Claims 18, 31, 32, 39, and 40 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bunkofske et al in view of Lundahl et al in view of Toprac et al in view of Wold et al and further in view of Hsuing et al. Claim 42 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Bunkofske et al in view of Lundahl et al in view of Toprac et al in view of Hsuing et al in view of Wold et al.

Applicants acknowledge with appreciation the courtesy of Examiner West to conduct

an interview in this case on September 13, 2005. During the interview, the issues identified in

the outstanding Office Action were discussed as substantially summarized herebelow.

Regarding the objection to the specification, the specification has been amended as

suggested in the outstanding Office Action. Thus, it is respectfully submitted that the

objection to the specification has been overcome.

Regarding the objection to the drawings, on the replacement sheets, Figures 1-5, 7, 8,

9A, and 9B have been redrawn to show labels on the elements. Thus, it is respectfully

submitted that the objection to the drawings has been overcome.

Regarding the objection to the claims, the claims have been amended to address the

informalities. Thus, it is respectfully submitted that the objection to the claims has been

overcome.

Regarding the 35 U.S.C. § 112, second paragraph, rejection to Claims 1-42, 47, and 48,

these claims have been amended to more particularly point out the claimed features, although it

is respectfully submitted that the issue associated with the recitation of "said applying said

updated adaptive scaling coefficients to each of said data parameters" in Claim 11 is proper

given the recitation of the step in Claim 1 of "applying said updated adaptive centering

coefficients to each of said data parameters in said PCA model." Furthermore, as a point of

clarification, the step of constructing a principal components analysis (PCA) model from the

data in for example Claim 1 has been clarified to define (1) that the PCA model includes

centering coefficients for the initial data and (2) that the centering coefficients are updated by

utilizing both previous run data from the initial data and current data obtained from additional

observation of the data parameters. For specific support for this clarification, the examiner's

attention is invited to the following disclosure in Applicant's specification:

> In an embodiment of the present invention, an adaptive multivariate analysis is
> described for preparing a robust PCA model. Therein, the centering and scaling

coefficients are updated using an adaptation scheme. The mean values (utilized for centering) for each summary statistic are updated *from one observation to the next* using a filter, such as an exponentially weighted moving average (EWMA) filter shown as follows:

$$\overline{X}_{M,j,n} = \lambda \overline{X}_{M,j,n-1} + (1 - \lambda)\overline{X}_{j,n}, \qquad (8)$$

where $\overline{X}_{M,j,n}$ represents the calculated model mean value ("M") of the $j^{th}$ data parameter at the current run (or observation "n"), $\overline{X}_{M,j,n-1}$ represents the calculated model mean value ("M") of the $j^{th}$ data parameter at the previous run (or observation "n-1"), $\overline{X}_{j,n}$ represents the current value of the $j^{th}$ data parameter for the current run, and $\lambda$ is a weighting factor ranging from a value of 0 to 1. For example, when $\lambda=1$, the model mean value utilized for centering each data parameter is the previously used value, and, when $\lambda=0$, the model mean value utilized for centering each data parameter is the current measured value.[1] [emphasis added]

Thus, given this support and clarification, it is respectfully submitted that the 35 U.S.C. § 112, second paragraph, rejection has been overcome.

As discussed during the interview, Claims 19-24 are directed to statutory subject matter. Independent Claims 19 is written in Jepson format and defines an improvement in a principal components analysis (PCA) model *for monitoring a processing system* for processing a substrate during the course of semiconductor manufacturing. As such, Claim 19 provides a new and useful improvement to a model-based processing monitoring system, and thus satisfies the requirement of 35 U.S.C. § 101. Further, M.P.E.P. § 2106 identifies as a "safe harbor" those processes that require that physical acts be performed independent of and following the steps to be performed by a computer program. In the present case, the steps recited in Claims 19-24 provide information by which after completion of these steps, the monitoring of a processing system for processing a substrate during the course of semiconductor manufacturing can be performed. Hence, it is respectfully submitted that Claims 19-24 are statutory.

Regarding the rejections on the merits, as discussed during the interview, M.P.E.P. § 2143 requires for a *prima facie* case of obviousness that the prior art reference (or references

when combined) must teach or suggest all the claim limitations. With regard to Claim 1, Claim 1 defines steps of acquiring additional data from the processing system after constructing a PCA model, adjusting centering coefficients of the PCA model by utilizing both previous run data from initial data and current data obtained after construction of the PCA model to produce updated adaptive centering coefficients for each of the data parameters in the PCA model, and applying the updated adaptive centering coefficients to each of the data parameters in the PCA model.

The outstanding Office Action acknowledges on page 11, lines 8-12, that Bunkofske et al and Lundahl et al do not teach acquiring additional data from the processing system to form an adjusted centering coefficient. The outstanding Office Action asserts on page 11, lines 19-21, that Toprac et al disclose at column 18, lines 27-46, obtaining a mean of the data parameters and adjusting the mean data parameters to form an updated mean. The outstanding Office Action then asserts thereafter that it would be obvious to modify the invention of Bunkofske et al and Lundahl et al to specify that the method acquire additional data from the processing system to form an adjusted centering coefficient to produce a more exact value of the centering coefficient as well as increase the accuracy by applying a centering coefficient that is consistently updated.

However, Toprac et al specifically discloses that:

> For example, preprocessing may include outlier rejection. Outlier rejection is a gross error check ensuring that the received data is reasonable in light of the historical performance of the process. This procedure involves comparing each of the MOSFET processing errors to its corresponding predetermined boundary parameter. In one embodiment, even if one of the predetermined boundaries is exceeded, the error data from the entire semiconductor wafer lot is generally rejected.

> To determine the limits of the outlier rejection, *thousands of* actual semiconductor manufacturing fabrication ("fab") *data points* are collected. The standard deviation for each error parameter in this collection of data is then calculated. In one embodiment, for outlier rejection, nine times the standard

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[1] Specification, numbered paragraphs [0090] to [0093].

deviation (both positive and negative) is generally chosen as the predetermined boundary. This was done primarily to ensure that only the points that are significantly outside the normal operating conditions of the process are rejected.

***Preprocessing may also smooth the data,*** which is also known as filtering. Filtering is important because the error measurements are subject to a certain amount of randomness, such that the error significantly deviates in value. Filtering the review station data results in a more accurate assessment of the error in the MOSFET processing control input signal settings. In one embodiment, the MOSFET processing control scheme utilizes a filtering procedure known as an Exponentially-Weighted Moving Average ("EWMA") filter, although other filtering procedures can be utilized in this context. [2]

Toprac et al later disclose that the data is colleted and preprocessed, and then processed to generate an estimate of the current errors in the MOSFET processing control input settings.[3] Thus, after outlier rejection and EWMA smoothing, the preprocessed data is incorporated into a control model.

Hence, in Toprac et al, an exponentially weighted moving average (EWMA), which the Office Action has associated with centering coefficients, is used to filter (i.e. smooth) input data values to a control model. The "new" and the "previous" EWMA averages disclosed with regard to Equation (1) in Toprac et al do not refer to subsequently acquired additional data points made after a control model has been constructed. Accordingly, Toprac et al do not disclose or suggest acquiring additional data from the processing system, adjusting centering coefficients of a PCA model by utilizing both previous run data from initial data and current data obtained from additional observation of the data parameters to produce updated adaptive centering coefficients for each of the data parameters in the PCA model and applying the updated adaptive centering coefficients to each of the data parameters in the PCA model.

Toprac et al do disclose in relation to Figure 10 that applying the wafer electrical test (WET) prediction model may yield either a new value for the MOSFET processing input

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[2] Toprac et al, col. 18, lines 9-36.
[3] Toprac et al, col. 19, lines 31-33.

parameter or a correction to the existing MOSFET processing control input parameter.[4] <u>Toprac</u>

<u>et al</u> further disclose that:

> Some alternative embodiments may employ a form of feedback to
> improve the modeling of characteristic parameters. The implementation of this
> feedback is dependent on several disparate facts, including the tool's sensing
> capabilities and economics. One technique for doing this would be to monitor
> at least one effect of the model's implementation and update the model based on
> the effect(s) monitored. The update may also depend on the model. For
> instance, a linear model may require a different update than would a non-linear
> model, all other factors being the same.[5]
>
> &ast; &ast; &ast; &ast;

> The present embodiment furthermore provides that the models be updated. This
> includes, as set forth in boxes 1450-1460 of FIG. 14, monitoring at least one
> effect of modifying the MOSFET processing recipe control input parameters
> (box 1450) and updating the applied model (box 1460) based on the effect(s)
> monitored. For instance, various aspects of the MOSFET processing tool
> 1210's operation will change as the MOSFET processing tool 1210 ages. By
> monitoring the effect of the MOSFET processing recipe change(s) implemented
> as a result of the characteristic parameter (e.g., workpiece 1205 gate critical
> dimensions) measurement, the necessary value could be updated to yield
> superior performance.[6]

Hence, while <u>Toprac et al</u> permits model updating based on observations of how well the

model tracks changes to the processing tool, there is no disclosure in <u>Toprac et al</u> that the model

"update" involves updating centering coefficients. Indeed, the fact that the processing tool has

aged to the point that the model is inaccurate implies that it is too late to correct the model in

<u>Toprac et al</u> by a weighted average change. Applicant submits that a weighted average change

either weights heavily the old average values upon which the model is inaccurate (and thus

useless) or weights heavily the new observations upon which there would be no statistically

significant basis upon which to form a new corrected control model (and thus also useless).

Hence, to one of ordinary skill in the art at the time of the invention, a combination of

<u>Toprac et al</u> with the other art of record (even if proper) would not produce or suggest the

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[4] <u>Toprac et al</u>, col. 12, line 61, to col. 13, line 1.
[5] <u>Toprac et al</u>, col. 13, lines 8-17.
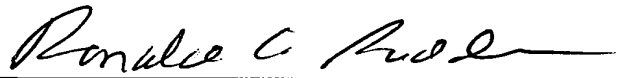[6] <u>Toprac et al</u>, col. 20, line 64, to col. 21, line 9.

claimed invention. Thus, Claims 1, 19, 25, 33, 41, 47, and 48 and the claims dependent

therefrom are believed to patentably define over the references in the outstanding Office

Action.

Consequently, in view of the present amendment and in light of the above discussions,

the outstanding grounds for rejection are believed to have been overcome. The application as

amended herewith is believed to be in condition for formal allowance. An early and favorable

action to that effect is respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

Customer Number

**22850**

Steven P. Weihrouch
Attorney of Record
Registration No. 32,829

Ronald A. Rudder, Ph. D.
Registration No. 45,618

Tel:  (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/03)
SPW:EDG:RAR:clh
Attachments:   Letter Submitting Replacement Drawings

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24

### Amendments to the Drawings

The attached sheets of drawings include changes to Fig. 1-5, 6A, 7, 8, 9A, and 9B.

These sheets, which include Fig. 1-5, 6A, 7, 8, 9A, and 9B, replace the original sheets including

Fig. 1-5, 6A, 7, 8, 9A, and 9B.


Attachment: Replacement Sheets.